Appendix II

8. Claims

While a few of the embodiments of the present invention have been explained, it will be readily apparent to those skilled in the art of the various modifications which can be made to the present invention without departing from the spirit and scope of this application as it is encompassed by the following claims.

What I claim as my invention is:

1. An apparatus for protection of an assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, the apparatus comprising at least:
    (a) A shaft and shaft mounted components with bores fitted to said shaft;
    (b) Shaft mounting surfaces that are portions of the shaft surfaces underneath or in close proximity to shaft mounted components;
    (c) Mounting bore surfaces that are bore surfaces of the shaft mounted components fitted to the shaft;
    (d) Stress concentrated areas that are portions of the shaft mounting surfaces or portions of the mounting bore surfaces being subject to local high mechanical stresses;
    (e) Reserves of sacrificial metal being either mounted or deposited, at least partially, to said shaft mounting surfaces and/or to said mounting bore surfaces, said reserves of sacrificial metal being connected electrically to the shaft and to the shaft mounted components, said reserves of sacrificial metal

being anodic to the shaft and to the shaft mounted components therefore providing cathodic protection to both the shaft and the shaft mounted components against corrosion and preventing corrosion related failures in stress concentrated areas.

2. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 1, wherein

(a) the shaft mounting surfaces have at least a contact free shaft mounting area that is substantially free from contact with the shaft mounted components after completion of the assembly of shaft / shaft mounted components;

(b) the mounting bore surfaces have at least a contact free mounting bore area that is substantially free from contact with the shaft after completion of the assembly of shaft / shaft mounted components;

(c) the stress concentrated areas is substantially included in the contact free shaft mounting area or in the contact free mounting bore surfaces.

(d) the reserves of sacrificial metal are either mounted or deposited to said contact free shaft mounting areas and/or to said contact free mounting bore areas, said reserves of sacrificial metal being connected electrically to the shaft and to the shaft mounted components, said reserves of sacrificial metal being anodic to the shaft and to the shaft mounted components therefore providing cathodic protection to both the shaft and the shaft mounted

components against corrosion and preventing corrosion related failures in the stress concentrated areas.

3. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 1, wherein the reserves of sacrificial metal are zinc or zinc alloy deposited to the shaft mounting surfaces or to the mounting bore surfaces.

4. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 1, wherein the reserves of sacrificial metal are zinc or zinc alloy deposited to the shaft mounting surfaces or to the mounting bore surfaces by inorganic zinc silicate coating, electroplating, thermal spraying or galvanizing.

5. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 1, wherein

   (a) the shaft mounting surfaces and the mounting bore surfaces are covered by residual mounting lubricant / sealant;

   (b) the reserves of sacrificial metal are sacrificial metals contained within the residual mounting lubricant / sealant that are deposited to the shaft mounting surfaces and to the mounting bore surfaces.

6. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 1, wherein the reserves of sacrificial metal being either mounted or deposited, at least partially, to said shaft mounting surfaces only or to said mounting bore surfaces only, said reserves of sacrificial metal being connected electrically to the shaft and to the shaft mounted components, said reserves of sacrificial metal being anodic to the shaft and to the shaft mounted components therefore providing cathodic protection to both the shaft mounting surfaces and to the mounting bore surfaces against corrosion and preventing corrosion related failures in stress concentrated areas.

7. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 2, wherein

   (a) the contact-free shaft mounting areas are portions of shaft fillet and its immediate peripheries or portions of shaft groove and its immediate peripheries that are substantially free from contact with the shaft mounted components after completion of assembly of shaft / shaft mounted components;

   (b) the contact-free mounting bore areas are portions of the bore surfaces of the shaft mounted components being fitted over or in close proximity to the shaft fillet or the shaft groove.

8. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 2, wherein

(a) the assembly of shaft / shaft mounted component is an assembly of axle / axle mounted bearing of a railway vehicle;

(b) the contact-free shaft mounting areas are portions of axle fillet surfaces, axle groove surfaces, axle journal surfaces or axle dust guard surfaces being substantially free from contact with the axle mounted bearing;

(c) the contact-free mounting bore areas are portions of bore surfaces of the axle mounted bearing components including backing rings, seal wear rings and spacer rings.

9. An apparatus for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, the apparatus comprising at least:

(a) A shaft and shaft mounted components;

(b) Internal lubricant encased within the shaft mounted components;

(c) Contact-free internal areas that are portions of internal surfaces of the shaft mounted components being in contact with the internal lubricant and being substantially free from contact with other shaft mounted components;

(d) Internal reserves of sacrificial metal being either mounted or deposited, at least partially, to said contact-free internal areas, said internal reserves of sacrificial metal being connected electrically to the shaft mounted components, said internal reserves of sacrificial metal being anodic to the

shaft mounted components therefore providing cathodic protection to the shaft mounted components against corrosion.

10. The apparatus for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 9, wherein the internal reserves of sacrificial metal are zinc or zinc alloy deposited to the contact-free internal areas.

11. The apparatus for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 9, wherein the internal reserves of sacrificial metal are magnesium or magnesium alloys and are mounted to the contact-free internal areas.

12. The apparatus for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 9, wherein

    (a) the assembly of shaft / shaft mounted component is an assembly of axle / axle mounted bearing of a railway vehicle;

    (b) the contact-free internal areas are portions of bearing cup surface, bearing spacer ring surface being in contact with internal lubricant and being substantially free from contact with other bearing components.

13. An apparatus for protection of an assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, the apparatus comprising at least:

(a) A shaft with one or a plurality of adjacent varying diameter sections thereby defining, in each section, a maximum sectional diameter and a minimum sectional diameter;

(b) Shaft mounted components mounted to said shaft with at least one gap between the shaft mounted components, said gap making one of the varying diameter sections of said shaft exposed to corrosion or impact damages and defining an exposed varying diameter section of said shaft ;

(c) Stress concentrated areas that are portions of the adjacent varying diameter sections of said shaft or portions of the shaft mounted components, said stress concentrated areas being subject to local high mechanical stresses;

(d) A sealing member in resilient material, being mounted to the exposed varying diameter section of said shaft together with one of the shaft mounted components, covering at least partially said exposed varying diameter section of said shaft against possible impact damages, sealing at least one of the joints between the exposed varying diameter section of said shaft and the shaft mounted components, protecting the stress concentrated area within or adjacent to the exposed varying diameter section against possible corrosion damages.

14. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, as recited in Claim 13, wherein the sealing member is at one end mounted / sealed on one of the shaft mounted components and at the other end mounted / sealed to the exposed varying diameter

section of the shaft, said the other end of the sealing member having a bore diameter substantially smaller than the maximum sectional diameter of the exposed varying diameter section but larger than the minimum sectional diameter of the exposed varying diameter section and having a body length substantially longer than the exposed varying diameter section of the shaft.

15. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, as recited in Claim 13, wherein the sealing member is at one end mounted / sealed on one of the shaft mounted components and at the other end mounted / sealed on the other shaft mounted component, said sealing member having a body length substantially longer than the exposed varying diameter section of the shaft.

16. The apparatus for protection of the assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, as recited in Claim 13, wherein

    (a) the assembly of shaft / shaft mounted components is an assembly of axle / axle mounted bearing / axle mounted wheel of a railway vehicle;

    (b) the shaft varying diameter sections are axle dust guard section, axle fillet section or axle groove section adjacent to the axle mounted wheel and/or the axle mounted bearing;

(c) the sealing member is made of elastomer and is mounted to outer or inner periphery of a ring component of the axle mounted bearing.

17. A method for protection of an assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, the method comprising at least:

(a) Determining stress concentrated areas on the shaft surfaces and/or on the bore surfaces of the shaft mounted components that are subject to local high mechanical stresses;

(b) Selecting a contact-free shaft mounting area and/or a contact-free mounting bore area, said contact-free shaft mounting areas being a portion of the shaft surface substantially free from contact with the shaft mounted component and in close proximity to said stress concentrated areas, said contact-free mounting bore areas being a portion of the bore surface of the shaft mounted components substantially free from contact with the shaft and in close proximity to said stress concentrated areas;

(c) Mounting or depositing, at least partially, reserves of sacrificial metal to said selected contact-free shaft mounting areas and/or to said selected contact-free mounting bore areas, said reserves of sacrificial metal being connected electrically to the shaft and the shaft mounted components, said reserves of sacrificial metal being anodic to the shaft and to the shaft mounted components therefore providing cathodic protection to both the shaft and the

shaft mounted components against corrosion and preventing corrosion related failures in stress concentrated areas;

(d) Installing the shaft mounted components by the bores to the shaft.

18. The method for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 17, wherein the reserves of sacrificial metal are zinc or zinc alloy deposited to the contact-free shaft mounting areas or to the contact-free mounting bore areas.

19. The method for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 17, wherein the reserves of sacrificial metal are zinc or zinc deposited to the contact-free shaft mounting areas or to the contact-free mounting bore areas by inorganic zinc silicate coating, electroplating, thermal spraying or galvanizing.

20. The method for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 17, wherein the reserves of sacrificial metal are deposited to the contact-free shaft mounting areas and to the contact-free mounting bore areas together with mounting lubricant / sealant prior to the assembly of shaft / shaft mounted component.

21. The method for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 17, wherein the reserves of sacrificial metal being either mounted or deposited, at least partially, to said contact-free shaft mounting areas only or to said contact free mounting bore areas only, said reserves of sacrificial metal being connected electrically to the shaft and to the shaft mounted components, said reserves of sacrificial metal being anodic to the shaft and to the shaft mounted components therefore providing cathodic protection to both the shaft surfaces and to the bore surfaces against corrosion and preventing corrosion related failures in stress concentrated areas.

22. The method for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 17, wherein

(a) the contact-free shaft mounting areas are portions of shaft fillet and its immediate peripheries or portions of shaft groove and its immediate peripheries that are substantially free from contact with the shaft mounted components after completion of assembly of shaft / shaft mounted components;

(b) the contact-free mounting bore areas are portions of the bore surfaces of the shaft mounted components being fitted over or in close proximity to the shaft fillet or the shaft groove.

23. The method for protection of the assembly of shaft / shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 17, wherein

(a) the assembly of shaft / shaft mounted component is an assembly of axle / axle mounted bearing / axle mounted wheel of a railway vehicle;

(b) the contact-free shaft mounting areas are portions of axle fillet surfaces, axle groove surfaces, axle journal surfaces and axle dust guard surfaces being substantially free from contact with the axle mounted components;

(c) the contact-free mounting bore areas are portions of bore surfaces of axle mounted bearing components including backing rings, seal wear rings and spacer rings.

24. A method for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, the apparatus comprising at least:

(a) Selecting contact-free internal areas that are portions of internal surfaces of the shaft mounted components being in contact with internal lubricant and being substantially free from contact with other shaft mounted components once the shaft mounted components are assembled to the shaft;

(b) Mounting or depositing internal reserves of sacrificial metal, at least partially, to said contact-free internal areas, said internal reserves of sacrificial metal being connected electrically to the shaft mounted components, said internal reserves of sacrificial metal being anodic to the shaft mounted components therefore providing cathodic protection to the shaft mounted components against corrosion;

(c) Adding internal lubricant to the internal surface of shaft mounted components;

(d) Installing the shaft mounted components to the shaft.

25. The method for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 24, wherein the internal reserves of sacrificial metal are zinc or zinc alloy deposited to the contact-free internal areas.

26. The method for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 24, wherein the internal reserves of sacrificial metal are magnesium or magnesium alloys and are mounted to the contact-free internal areas.

27. The method for protection of internal surfaces of shaft mounted components against corrosion in a machinery or a vehicle, as recited in Claim 24, wherein

(a) the assembly of shaft / shaft mounted component is an assembly of axle / axle mounted bearing of a railway vehicle;

(b) Contact-free internal areas are portions of bearing cup surface, bearing spacer ring surface being in contact with internal lubricant and being substantially free from contact with other bearing components.

28. A method for protection of an assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, the method comprising at least:

(a) Determining maximum sectional diameters and minimum sectional diameters in one or a plurality of adjacent varying diameter sections of said shaft;

(b) Mounting shaft mounted components to said shaft with at least a gap between the shaft mounted components, said gap making one of the varying diameter sections of said shaft exposed to corrosion or impact damages and defining an exposed varying diameter section of said shaft;

(c) Mounting a sealing member in resilient material to the exposed varying diameter section of said shaft, said sealing member protecting at least partially the exposed varying section of said shaft against possible impact damages, sealing at least one of the joints between the exposed varying diameter section of said shaft and the shaft mounted components, protecting stress concentrated areas on the surface of said shaft within or adjacent to the exposed varying diameter section against possible corrosion damages, said stress concentrated areas being subject to local high mechanical stresses.

29. The method for protection of the assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, as recited in Claim 28, wherein the sealing member is at one end mounted / sealed on one of the shaft mounted components and at the other end mounted to the exposed varying diameter section of the shaft, said the other end of the sealing member having a bore diameter substantially

smaller than the maximum sectional diameter of the exposed varying diameter section but larger than the minimum sectional diameter of the exposed varying diameter section and having a body length substantially longer than the exposed varying diameter section of the shaft.

30. The method for protection of the assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, as recited in Claim 28, wherein the sealing member is at one end mounted / sealed on one of the shaft mounted components and at the other end mounted / sealed on the other shaft mounted component, said sealing member having a body length substantially longer than the exposed varying diameter section of the shaft.

31. The method for protection of the assembly of shaft / shaft mounted components against corrosion and/or impact damages in a machinery or a vehicle, as recited in Claim 28, wherein

    (a) the assembly of shaft / shaft mounted components is an assembly of axle / axle mounted bearing / axle mounted wheel of a railway vehicle;

    (b) the varying diameter sections of said shaft are the axle dust guard section, axle fillet section or axle groove section adjacent to the axle mounted wheel and to the axle mounted bearing.

(c) the sealing member is made of elastomer and is mounted to outer or inner periphery of a ring component of the axle mounted bearing.